



Preparing your students for the FLOW field trip

In order to optimize this learning experience, we ask you to cover the following topics with your students before your visit to the Bolsa Chica Ecological Reserve:

- 1) Marine Wetlands/ Tidal salt marshes (Definitions and Importance)
- 2) Plankton, Phytoplankton, Zooplankton (Definitions and Importance)
- 3) Food webs
- 4) Runoff, Nutrients and Eutrophication
- 5) Harmful Algae
- 6) What they will be doing during their visit (please go over the student field worksheet with them)
- 7) Field Trip rules and behavior expectations

Below, we offer a number of suggestions for activities and resources that you can use to cover these topics with your students in your classroom in preparation for their field trip. Please feel free to pick and choose the activities that you think are most appropriate for your students and your curriculum. We also offer here three worksheets for you to use before, during and after the field trip. We hope these will be useful to you and your students.

Useful Activities and Resources

Click on the following links for classroom activities and games about wetlands:

<http://idahoptv.org/dialogue4kids/season6/wetlands/shrinkwetland.cfm>

<http://www.wetland.org/downloads/Marsh%20Market.pdf>

<http://www.nwrc.usgs.gov/fringe/function.html>

Click on the following links for sites that offer more information about wetlands:

<http://www.amigosdebolsachica.org/birdsandscience.htm#functions>

http://water.epa.gov/type/wetlands/cwt.cfm#why_imp

http://www.nwrc.usgs.gov/fringe/about_ff.html

Click on the following links for videos about plankton that you can show to your students:

http://education.nationalgeographic.com/education/media/plankton-revealed/?ar_a=1

<http://estuaries.noaa.gov/teachers/plankton.aspx>

<http://ed.ted.com/lessons/the-secret-life-of-plankton>

http://cmore.soest.hawaii.edu/video/steward_video.htm

FLOW Program: Description of Shadowing Activities

Arrival

- 9:00 AM Bus arrives at the Bolsa Chica Visitor Center (park by basketball court)
- 9- 9:20 AM Welcome speech; brief intro to rules and expectations; students use the restrooms
- 9:20-9:30 AM Half of the class gets back into bus and drive to the wetland side/ Other students walk to the visitor center
- 9:30- 10:00 AM Students work on their first station

WETLAND SIDE

Activities in each station last approx. 20-30 min.

Station A (~15 students) Brief tour of the wetland: *focus is on the ecological importance of this ecosystem and connectivity with the ocean*

Station B (~15 students in 2 groups of 7) Students assist Citizen Scientists in: *collecting plankton with plankton nets, measuring salinity with refractometers and temperature with thermometers and recording data in datasheets.*

BEACH SIDE

Station A (~15 students in 3 groups of 4-5; tables outside) Students perform Chemical Tests for Water Quality Assessment: *Colorimetric test kits are used to measure Nitrates, Ammonia, Phosphates and pH.*

Station B (~15 students; tables inside) Students use microscopes to observe and identify plankton organisms: *Focus is on harmful algae species*

- 10:00 AM Students switch from station A to station B and vice-versa
- 10:30 AM Students cross sides (bus from wetland drives students from wetland to Visitor Center and then back from Visitor Center to wetland)
- 11:10 AM Students switch from station A to station B and vice-versa
- 11:45 AM Students from wetland side cross to beach side to reunite with rest of the group-
- 12:00 PM END OF FLOW ACTIVITIES

**Amigos de Bolsa Chica Flow Program
Pre-Visit Preparation Worksheet**

Student: _____ Date: _____

1) This worksheet is meant to help you in preparing for your upcoming field trip to the Bolsa Chica Ecological Reserve. Your visit will include a visit to the beach and to the Bolsa Chica Wetland, which is a marine wetland. Talk to your teacher and classmates and then answer:

a) What is a marine wetland?

b) Why are marine wetlands special places that should be conserved?

2) During your trip to the Bolsa Chica Ecological Reserve you will help Citizen Scientists to collect and identify plankton. What are plankton?

3) Compare and Contrast:

| | Phytoplankton (aka microalgae) | Zooplankton |
|--------------------------------------|-----------------------------------|-------------|
| Source of energy | | |
| Get eaten by ... | | |
| How big? | | |
| Look and behave more like an animal? | | |
| Has chlorophyll? | | |
| Role in the food web | | |
| Examples | | |

4) TRUE OR FALSE? *“Phytoplankton are primary producers and, like plants, use photosynthesis to produce their own food”*. If that is true, what “ingredients” and conditions do phytoplankton need to grow and prosper? (Hint: think of houseplants and gardens! What do farmers and homeowners do to ensure that their plants thrive?)

5) *“Every year, several tons of fertilizers are used in farms and homegardens all over the world. Plant fertilizers are rich in Nitrogen, Phosphorus and Potassium, which serve as the building blocks for plant cells. Thus the need to provide crops with nutrients. However, much of those fertilizers end up not being absorbed by the plants they were intended for and excess fertilizers tend to accumulate in the soil. The runoff of fertilizers and sewage are the main causes of coastal eutrophication.”*

Talk to a classmate about the statement above and then answer:

a) What do you think happens to this extra fertilizers that have accumulated in the soil of farms and homegardens when it rains?

b) Can the nutrients get to the ocean? _____ And if so, what would be the consequences of that? (Hint: think about your answer for question #5)

c) On a separate sheet of paper, draw a picture or a diagram to illustrate your discussion.

6) Read the newspaper article provided to you by your teacher and then answer the following questions:

- a) What is this article about?
- b) What is the relationship between the sick pelicans the article talks about and phytoplankton?
- c) Are all phytoplankton harmful? Explain.
- d) The toxin mentioned in the article (Domoic Acid) bioaccumulates in the food chain. These plankton-produced toxins can poison and kill not only pelicans, but other mammals such as dolphins, sealions and even humans who have eaten seafood contaminated with this toxin. Unfortunately, scientists still don't know how to control the occurrence of such toxins in the ocean. **What, then, in your opinion should be done by coastal managers to prevent human poisoning caused by the toxins produced by these types of phytoplankton?**

Brown Pelican Rescue Effort Currently Under Way

Local Wildlife Organizations Take Part in Major Effort to Reduce Number of Deaths

Last week, wildlife rescuers were hit with a wave of sick and dying brown pelicans from Santa Barbara to San Diego.

The pelicans exhibit neurological disorders, including toe clenching and a side-to-side head movement, characteristic of do-

moic acid poisoning. A rush is on to locate and capture the birds—their chance for survival depends on immediate medical attention. Aggressive fluid therapy can flush the toxin from an animal's system in a relatively short period of time.

Domoic acid is a neurotoxin produced by a particular species of single-celled plankton, or diatom, *Pseudo-nitzschia australis*—the dominant species of phytoplankton along our coast. Scientists are still uncertain as to what causes the microscopic creature to produce different levels of domoic acid at different times, but the effect can be devastating to marine animals. As the toxin moves up the food chain, fish become contaminated, then the birds and marine mammals.

Diatoms are not all bad—in fact they are vital to life on earth, responsible for producing (through photosynthesis) an estimated 80% of our oxygen.

International Bird Rescue Research Center (IBRRC) in San Pedro, specialists in treating domoic acid poisoning, is coordinating rescue efforts for birds found between Santa Barbara County and Orange County.

With help from a net-

work of wildlife rescue organizations, including Santa Barbara Wildlife Care Network, Wildlife Care of Ventura County, Wildlife Rescue, the California Wildlife Center, and Whale Rescue Team, sick pelicans are being found and transported quickly.

At this time, no state or federal agency has stepped forward to help offset the costs of caring for the numerous sea birds being affected by domoic acid poisoning.

IBRRC is taking on the considerable responsibility and great expense to see these birds through rehabilitation and release back into the wild.

To help with the cost, IBRRC has created an “adopt a pelican” program. More information about how to assist can be found



PATIENTS—Brown pelicans recuperate after being treated for domoic acid poisoning, which is currently affecting the local bird population in large numbers.

on their web site at: <http://www.ibrrc.org/adopt-pelican.html>.

To report a possibly sick pelican, contact IBRRC at 310-514-2573.

BY REBECCA DMYTRYK

**Amigos de Bolsa Chica Flow Program
Pre-Visit Preparation Worksheet**

Student: **Answers KEY** Date: _____

- 1) This worksheet is meant to help you in preparing for your upcoming field trip to the Bolsa Chica Ecological Reserve. Your visit will include a visit to the beach and to the Bolsa Chica Wetland, which is a marine wetland. Talk to your teacher and classmates and then answer:
c) What is a marine wetland?

Students watch presentation by teacher, play games, discuss with classmates and then come up with a definition for marine wetlands. For example: Marine wetlands are coastal areas filled with seawater that receive little or no freshwater input.

- d) Why are marine wetlands special places that should be conserved?

Students should be able to list at least 5 reasons. For example: marine wetlands protect upland areas from floods and erosion; they provide habitat for migratory birds and endangered species; they serve as nurseries for marine fish and shellfish; they filter chemicals and sediments from runoff out of the water before it reaches the ocean; they serve local communities by providing a space for recreation and education; they sequester and store can sequester and store large amounts of carbon due to their rapid growth rates and slow decomposition rates.

- 2) During your trip to the Bolsa Chica Ecological Reserve you will help Citizen Scientists to collect and identify plankton. What are plankton?

Students watch presentation by teacher, play games, discuss with classmates and then come up with a definition for plankton. For example: Plankton are organisms that cannot swim against the water flow and therefore drift in the sea or fresh water. Most plankton are microscopic, single-celled organisms, but some are quite large such as jellies.

- 3) Compare and Contrast:

| | Phytoplankton (aka microalgae) | Zooplankton |
|--------------------------------------|---|---|
| Source of energy | Sunlight/ Photosynthesis | Eat phytoplankton and other zooplankton |
| Get eaten by ... | Zooplankton, mollusks, some small fish | Small fish, other zooplankton, mollusks, etc. |
| How big? | Very small (XXX) | Larger than phytoplankton (XXX) |
| Look and behave more like an animal? | No, they look and behave more like plants | Yes |
| Has chlorophyll? | Yes | No |
| Role in the food web | Primary Producers | Primary Consumers |
| Examples | Diatoms and most dinoflagellates | Copepods, Fish larvae, rotifers, tintinnids |

- 4) TRUE OR FALSE? *“Phytoplankton are primary producers and, like plants, use photosynthesis to produce their own food”*. If that is true, what “ingredients” and conditions do phytoplankton need to grow and prosper? (Hint: think of houseplants and gardens! What do farmers and homeowners do to ensure that their plants thrive?)

TRUE. Like plants, phytoplankton need sunlight, water, carbon dioxide, oxygen and “fertilizers” or nutrients (mainly nitrogen and phosphorus, but also micronutrients such as iron and silica)

- 5) *“Every year, several tons of fertilizers are used in farms and homegardens all over the world. Plant fertilizers are rich in Nitrogen, Phosphorus and Potassium, which serve as the building blocks for plant cells. Thus the need to provide crops with nutrients. However, much of those fertilizers end up not being absorbed by the plants they were intended for and excess fertilizers tend to accumulate in the soil. The runoff of fertilizers and sewage are the main causes of coastal eutrophication.”*

Talk to a classmate about the statement above and then answer:

- d) What do you think happens to this extra fertilizers that have accumulated in the soil of farms and homegardens when it rains?

Students should be able to articulate in their own words that the rain washes off the excess fertilizers from the soil and transports them from agricultural and urban settings through the watershed (through creeks, channels, rivers, drainage systems, wetlands, etc) to the ocean (runoff pollution).

- e) Can these nutrients get to the ocean? YES And if so, what would be the consequences of that? (Hint: think about your answer for question #5)

Students should be able to articulate in their own words that the nutrients that make up plant fertilizers (mostly Nitrogen and Phosphorus) will also act as nutrients for phytoplankton and other primary producers in the ocean. With the help of the teacher (and the aid of the suggested videos, games, activities) students may also be able to explain eutrophication (i.e. excessive growth of primary producers in aquatic systems due to fertilization which causes the depletion of oxygen in the water body and often fish kills and dead zones).

- f) Then draw a picture or a diagram to illustrate your discussion.

Students pictures should include the SOURCE of the fertilizers and the components of the watershed through which the fertilizers travel to get to the ocean.

- 6) Read the newspaper article provided to you by your teacher and then answer the following questions:

e) What is this article about? For ex.: Pelicans getting sick because of a toxin produced by certain types of plankton that moves up the food chain and ultimately poisons sea birds, such as pelicans and marine mammals as well.

f) What is the relationship between the sick pelicans the article talks about and phytoplankton? Certain types of phytoplankton (in this case diatoms) produce a toxin that makes the pelicans sick. Students should understand that the pelicans do not eat the toxic phytoplankton! The toxic plankton gets eaten by zooplankton, which then gets eaten by fish, but these organisms are not affected by the toxin, which bioaccumulates

in the food web, poisoning higher consumers, such as pelicans, sea lions, dolphins, etc.

- g) Are all phytoplankton harmful? Explain. **No! Only a few species of phytoplankton produce toxins. In fact, phytoplankton are extremely beneficial because they produce oxygen (50-80% of all the oxygen we breath!), and they are the basis of aquatic foodwebs (serve as food for other aquatic life).**
- h) The toxin mentioned in the article (Domoic Acid) bioaccumulates in the food chain. These plankton-produced toxins can poison and kill not only pelicans, but other mammals such as dolphins, sealions and even humans who have eaten seafood contaminated with this toxin. Unfortunately, scientists still don't know how to control the occurrence of such toxins in the ocean. What, then, in your opinion should be done by coastal managers to prevent human poisoning caused by the toxins produced by these types of phytoplankton?

With the help of the teacher, students should brainstorm management actions to minimize the impacts of plankton-produced toxins. The teacher should make it clear that there is no way to prevent these toxins from occurring in the ocean, nor to control their spread, but should lead the conversation towards actions that can prevent HUMANS from eating contaminated seafood. Hopefully some students will suggest that managers should monitor the water so that they can warn seafood consumers about high levels of toxin-producing plankton in the water, and also close affected harvesting areas. The teacher should then tell the students that this what is currently done by the CA State Dept. of Public Health with help from Citizen Scientists, such as the ones the students will shadow during their visit to Bolsa Chica. The teacher should encourage students to articulate in writing and other creative ideas and strategies they come up with to prevent humans from getting sick because of harmful algal blooms.

Amigos de Bolsa Chica Flow Program
Shadowing Visit, Student Worksheet

Student: _____ Date: _____

Team Members: _____

WETLAND SIDE - Station A: Tour of the Wetland

Write here your notes about the Bolsa Chica Wetland History, Ecology, Conservation, etc.

WETLAND SIDE - Station B: Plankton and Data Collection

| Sampling Location | Time | Tide | Weather and wind | Type of collection | Water Temperature | Salinity |
|-------------------|------|------|------------------|--------------------|-------------------|----------|
| | | | | | | |

Name and describe the equipment and/or methods your team used to do the following:

Collect Plankton: _____

Measure Temperature: _____

Measure Salinity: _____

BEACH SIDE - Station C: Chemical Tests for Water Quality Analysis

| Chemical Analysis Variables | Data/ Results | Observations/ Notes |
|-----------------------------|---------------|---------------------|
| Ammonia: | | |
| Nitrates: | | |
| Phosphates: | | |
| pH: | | |

BEACH SIDE - Station D: Microscopy and Plankton Taxonomy

Using the microscope and ID charts, observe, draw and identify at least 4 plankton organisms found in the samples collected today.

| | |
|--|--|
| Species Name: _____ Plankton Group: _____ | Species Name: _____ Plankton Group: _____ |
| Species Name: _____ Plankton Group: _____ | Species Name: _____ Plankton Group: _____ |

Amigos de Bolsa Chica Flow Program
FOLLOW-UP Worksheet

Student: _____ Date: _____

1) During your visit to the Bolsa Chica you used a variety of scientific instruments to collect samples and data. Describe at least three of those instruments, explaining what they are used for and how you used them (you can draw pictures if it helps you to explain your ideas)

2) Why do scientists measure water temperature and salinity when they collect plankton?

3) Data analysis and Discussion: During your visit, you and your teammates performed water quality analysis using water samples collected from the Bolsa Chica wetland and/or the Tidal Inlet. Now, analyze your data and compare your results with that of other teams. For each variable that you measured, you and your group need to a) describe your observations and b) discuss your results.

Water Temperature: was the water temperature what you expected for that environment and weather conditions? Describe and explain your results.

Salinity: was the salinity of the water sample what you expected for that environment and weather conditions? Describe and explain your results.

Nutrients: were the nutrient levels in the water sample what you expected for that environment and weather conditions? Describe and explain your results.

pH: was the pH of the water sample what you expected for that environment and weather conditions? Describe and explain your results.

4) During your visit, you also had a chance to observe water samples under the microscope. Please describe what you observed in terms of:

a. Plankton abundance: Were there lots of organisms in the water?

b. Plankton composition: Was there a great variety of organisms or were they all of the same type? Were there any potentially harmful algae species?

c. Can you and your teammates come up with some possible theories about the chemical, physical and biological conditions that could explain the plankton abundance and composition that you observed?

5) Based on the results of your water quality analyses, and your observations during the trip to Bolsa Chica beach and wetlands, what recommendations would you make to the people who manage this ecological reserve?

6) What aspects of this visit did you enjoy the most? Which did you enjoy the least?

7) With your classmates and teacher, decide on a creative way to report your findings and your overall experience during your visit to the Bolsa Chica Ecological report. You can write a poem, compose a song, make a video, create a collage or draw picture... let your imagination FLOW!

Flow Post-Visit Evaluation Form (for Instructors)

Thank you so much for bringing your class to FLOW at the Bolsa Chica Ecological Reserve! We strive to continuously improve our programs and would sincerely appreciate your suggestions for how we can do that.

Your feedback will be used during our internal review process and also as part of the period reporting we do to our financial supporters and grant funding organizations.

Please make copies of the 2-page quiz about themes and topics covered during your shadowing visit to FLOW (last page of this form), and ask your students to answer the quiz.

Then, tally their answers here:

| Question | Correct Answer | # of students who ... | | |
|----------|----------------|------------------------|--------------|-------------------------|
| | | Answered this question | Got it right | Answered "I don't know" |
| 1 | C | | | |
| 2 | E | | | |
| 3 | B | | | |
| 4 | D | | | |
| 5 | A | | | |
| 6 | False | | | |
| 7 | False | | | |
| 8 | True | | | |
| 9 | True | | | |
| 10 | False | | | |
| 11 | True | | | |
| 12 | True | | | |
| 13 | False | | | |
| 14 | True | | | |
| 15 | True | | | |

Based on the tally above, your student's performance in the Follow-up Worksheet and your own observations, please rate the quality of FLOW program's elements, according to the following scale:

A= EXCELLENT! Keep it exactly as is.

B= GOOD, but it could be improved.

C= ACCEPTABLE, but needs to be revised.

F= POOR, it should be completely eliminated and/or replaced.

1. Teaching Materials:

1.a. Pre-visit preparation PowerPoint presentation:

Grade _____

Comments:

1.b. Instructions sheet and lesson plans provided before your visit

Grade _____

Comments:

1.c. Pre-visit Worksheet

Grade _____

Comments:

1.d. Field work worksheets

Grade _____

Comments:

1.e. Post-visit worksheet

Grade _____

Comments:

2. Field Trip Elements:

2.a. Presentations by our Citizen Scientists

Grade _____

Comments:

2.b. Plankton and water collection activities

Grade _____

Comments:

2.c. Mini-tour of the wetland

Grade _____

Comments:

2.d. Microscopy

Grade _____

Comments:

2.e. Chemical Analysis/ Water quality testing

Grade _____

Comments:

Logistics:

Scheduling of the visit

Grade _____

Comments:

Communication with Program Manager

Grade _____

Comments:

What additional learning tools, activities or resources could we add that would be helpful to increase our program's success in educating students about what we do at FLOW?

Finally, would you be interested and available to participate in teacher training events and activities aimed at improving the FLOW program?

Online/ email-based discussions with our Curriculum Developer (e.g. evaluate, review and edit lesson plans, worksheets, handouts, etc) in Spring and Summer of 2017

YES or NO?

In-person teacher training workshop: 1-day in August/2017

YES or NO?

FLOW PROGRAM POST-VISIT QUIZ (for students)

Multiple-choice questions: Mark the option that you think best completes or answers each of the sentences (1 point each)

1. A Marine Wetland is...
 - A) a city in Orange County, CA
 - B) the same thing as a lake
 - C) an area near the coast that is filled with seawater
 - D) all of the above
 - E) none of the above
 - F) I don't know

2. Wetlands are important because...
 - A) improve water quality
 - B) provide habitat for animals and plants
 - C) reduce flood damage
 - D) provide recreational opportunities
 - E) all of the above
 - F) I don't know

3. Phytoplankton are...
 - a) A type of chemical test used to evaluate water quality
 - b) Living organisms that use photosynthesis to produce their own food
 - c) A form of pollution that destroys the environment
 - d) Endangered birds that migrate to the Bolsa Chica wetlands every winter
 - e) All of the above
 - f) I don't know

4. After a few days of rain runoff usually brings fertilizers to wetlands and the ocean, and that may cause...
 - a) Aquatic plants and phytoplankton to grow too quickly, which can be a problem
 - b) Dissolved oxygen to decrease, sometimes killing fish and other living organisms
 - c) Eutrophication
 - d) All of the above
 - e) None of the above
 - f) I don't know

5. Which of the following variables are measured as part of a typical plankton-monitoring program, such as FLOW?

- a. Temperature, Salinity, pH and nutrients
- b. Phosphates, fecal coliforms and methane
- c. Salinity, conductivity and pressure
- d. Phosphates, pressure, and refraction
- e. All of the above
- f. I don't know

Mark "T" for True, "F" for False or "IDK" for I don't know (0.5 point each)

- 6. Any wetland, swamp or marsh is a marine wetland. A: _____
- 7. All phytoplankton organisms produce toxins that can kill pelicans, sea lions, and even humans. A: _____
- 8. It is possible for humans to create and restore wetlands. A: _____
- 9. Excessive use of fertilizers in farms, yards, lawns, fields and parks can cause marine pollution and problems. A: _____
- 10. Only scientists with advanced degrees from accredited universities are qualified to participate in environmental quality monitoring programs such as FLOW. A: _____
- 11. Weather conditions such as wind and rain can affect the composition and abundance of plankton in a given ocean area. A: _____
- 12. Silica is a critical nutrient for the growth of certain plankton groups. A: _____
- 13. The only source of nutrients for marine phytoplankton is urban runoff. A: _____
- 14. Phytoplankton are the basis of aquatic food webs and produce about half of all the oxygen available on Earth's atmosphere. A: _____
- 15. Ecological reserves, such as the Bolsa Chica wetlands are important sanctuaries for marine animals and therefore must be conserved. A: _____